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The Shapley Supercluster. III. Collapse dynamics and mass of the central concentration

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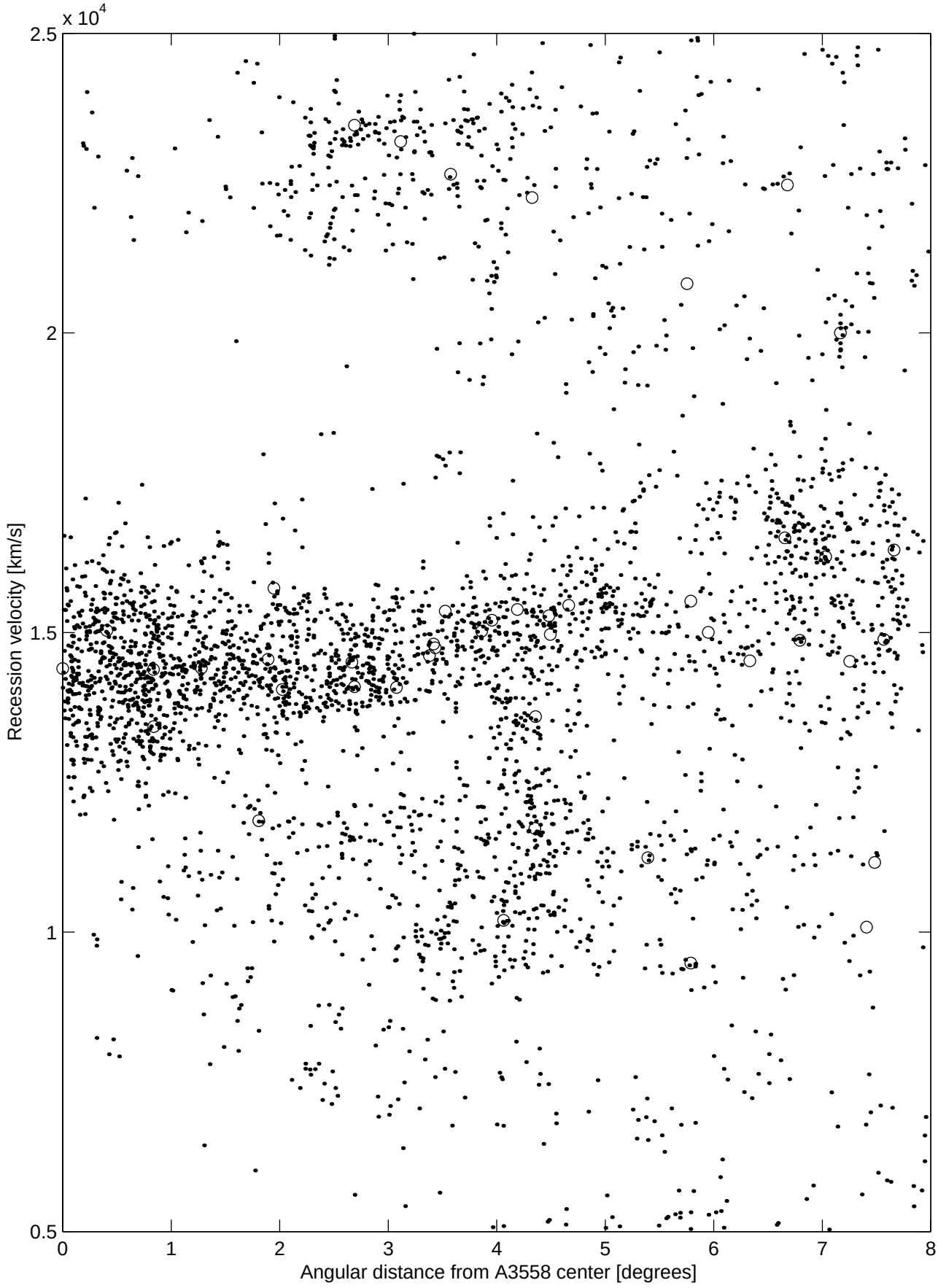
abstract We present the first application of a spherical collapse model to a supercluster of galaxies. Positions and redshifts of ~ 3000 galaxies in the Shapley Supercluster (SSC) are used to define velocity caustics that limit the gravitationally collapsing structure in its central part. This is found to extend at least to $8h^{-1}$ Mpc of the central cluster, A 3558, enclosing 11 ACO clusters. Infall velocities reach ~ 2000 km s^{-1}. Dynamical models of the collapsing region are used to estimate its mass profile. An upper bound on the mass, based on a pure spherical infall model, gives $M(< 8h^{-1}\mathrm{Mpc}) \lesssim 1.3 \times 10^{16} h^{-1} M_\odot$ for an Einstein-de Sitter (critical) Universe and $M(< 8h^{-1}\mathrm{Mpc}) \lesssim 8.5 \times 10^{15} h^{-1} M_\odot$ for an empty Universe. The model of Diaferio & Geller (1997), based on estimating the escape velocity, gives a significantly lower value, $M(< 8h^{-1}\mathrm{Mpc}) \approx 2.1 \times 10^{15} h^{-1} M_\odot$, very similar to the mass found around the Coma cluster by the same method (Geller et al. 1999), and comparable to or slightly lower than the dynamical mass in the virialized regions of clusters enclosed in the same region of the SSC. In both models, the overdensity in this region is substantial, but far from the value required to account for the peculiar motion of the Local Group with respect to the cosmic microwave background.


x 10^4
2.5
2
1.5
1
0.5
Recession velocity [km/s]
0
1
2
3
4
5
6
7
8
Angular distance from A3558 center [degrees]